

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

**REMARKS**

Claims 1-10 are pending in the application.

Claims 1-6 have been allowed.

Claims 9 and 10 have been rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite.

Specifically, the Examiner criticizes the following language in Claims 9 and 10: “glass powder having lower transition temperature having a glass transition temperature.” He suggests that “having lower transition temperature” be deleted.

Applicants have deleted the phrase “having lower transition temperature.” Applicants submit that the claims are clear and definite and respectfully request that the Examiner reconsider and withdraw the § 112 rejection.

The Examiner has objected to the specification for informalities. The Examiner asserts that the glass used in the instant invention is not defined by a composition and therefore does not provide one of ordinary skill in the art with sufficient information to reproduce the instant invention. The Examiner criticizes the specification on the basis that it refers to trade names for certain chemical materials, the composition of which may change over time. Therefore, the Examiner requests that Applicants supply product information sheets for the trade names and amend the specification to include the composition.

Applicants submit herewith data sheets showing the properties of ASF-1340. Applicants have also amended the specification to recite the chemical composition of ASF-1340 used in the examples. Applicants submit that the specification is clear and definite and fully enabled and

Appln. No.: 09/832,209  
Amendment under 37 C.F.R. § 1.111

Q64055

therefore, Applicants respectfully request that the Examiner reconsider and withdraw the rejection.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

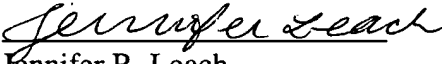
Respectfully submitted,

SUGHRUE MION, PLLC  
Telephone: (202) 293-7060  
Facsimile: (202) 293-7860

WASHINGTON OFFICE

**23373**

CUSTOMER NUMBER

  
Jennifer R. Leach  
Registration No. 54,257

Date: July 26, 2004



ASF/ATG Powder Glass for Electronics

# **POWDER GLASS**

AP Dielectric Glass Pastes for Thick-film Printing

# **GLASS PASTE**

2004.April version

ASAHI GLASS CO., LTD. Electronic Materials & Products General Div.

Shinyurakucho Bldg., 1-12-1 Yurakucho Chiyoda-Ku, Tokyo 100-8405 JAPAN

Phone : +81-(0)3-3218-5433 Facsimile : +81-(0)3-3218-7861

## ASF Powder Glass for Hermetic Seal

Code	Glass Type	Firing Condition Temp.-Time (°C-min)	Thermal Expansion Coeff. ( $\times 10^{-7}/^{\circ}\text{C}$ ) 25~300°C	Specific Gravity	Viscosity Property (DTA)			Electrical Property			Particle Property		Granulated Powder Mesh Pass	Color (After Firing)	Lead Free or Contd.
					Point (°C)	Softening Point (°C)	Crystallization Temp. (°C)	Volume Resistance $\log \rho$ ( $\Omega \cdot \text{cm}$ ) 150°C	Dielectric Constant $\epsilon$ 1MHz, 25°C	Dielectric Loss $\tan \delta$ ( $\times 10^{-4}$ ) 1MHz, 25°C	Average Particle Size ( $\mu\text{m}$ )	Particle Size (Center Value) (D50) ( $\mu\text{m}$ )	Sieving Size Mesh Pass		
ASF110	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -R <sub>2</sub> O	880-5	48	2.3	510	715	-	14	5	20	5.5	-	150	-	Free
ASF111F	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -R <sub>2</sub> O	880-5	48	2.3	510	715	-	14	5	20	5.5	-	150	-	Free
ASF200R	SiO <sub>2</sub> -R <sub>2</sub> O	880-5	92	2.6	440	650	-	12	7	20	10.0	-	150	-	Free
ASF200G	SiO <sub>2</sub> -R <sub>2</sub> O	880-5	92	2.6	440	650	-	12	7	20	-	-	-	100	Free
ASF208	SiO <sub>2</sub> -R <sub>2</sub> O	880-5	92	2.6	440	650	-	12	7	20	10.0	-	150	-	Free
ASF208G	SiO <sub>2</sub> -R <sub>2</sub> O	880-5	92	2.6	440	650	-	12	7	20	-	-	-	100	Free
ASF100	SiO <sub>2</sub> -R <sub>2</sub> O	880-5	99	2.6	505	690	-	12	7	20	10.0	-	150	-	Free
ASF200G	SiO <sub>2</sub> -R <sub>2</sub> O	880-5	99	2.6	505	690	-	12	7	20	-	-	-	100	Free

● Powder glass suitable for various metallic materials, including iron, ferro-nickel alloys, Kovar, etc.

● Crystalline glass powder has outstanding heat-resistance properties.

● Non-alkaline glass is also available for sealing Kovar.

● Suitable as glass powder, granulated powder and tablets.

● Granulated organic binders provide superior burn-out property.

## ASF Powder Glass for Low Temperature Sealing

Code	Glass Type	2004-April version Temp.-Time (°C-min)	Thermal Expansion Coeff. ( $\times 10^{-7}/^{\circ}\text{C}$ ) 25~300°C	Specific Gravity	Viscosity Property (DTA)			Electrical Property			Particle Property		Color (After Firing)	Lead Free or Contd.	
					Point (°C)	Point (°C)	Softening Temp. (°C)	Volume Resistance $\log \rho$ ( $\Omega \cdot \text{cm}$ ) 150°C	Dielectric Constant $\epsilon$ 1MHz, 25°C	Dielectric Loss $\tan \delta$ ( $\times 10^{-4}$ ) 1MHz, 25°C	Average Particle Size ( $\mu\text{m}$ )	Particle Size (Center Value) (D50) ( $\mu\text{m}$ )			Sieving Size Mesh Pass
ASF1200	Bi <sub>2</sub> O <sub>3</sub> -PbO	450-5	73	5.8	320	380	-	10	14	50	5.0	10.3	150	Black	Contd.
ASF1200M	Bi <sub>2</sub> O <sub>3</sub> -PbO	450-10	72	5.8	320	380	-	10	14	50	4.0	-	150	Black	Contd.
ASF1295	Bi <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub> -PbO	450-10	83	5.6	335	405	-	-	-	-	8.2	-	150	White	Contd.
ASF1302B	Bi <sub>2</sub> O <sub>3</sub> -PbO-ZnO	440-35	83	5.9	320	400	515	-	-	-	5.8	-	100	Black	Contd.
ASF1307	Bi <sub>2</sub> O <sub>3</sub> -PbO-ZnO	440-35	99	6.5	320	400	510	10	23	100	6.0	-	100	Yellow	Contd.
ASF1307F	Bi <sub>2</sub> O <sub>3</sub> -PbO-ZnO	440-20	97	6.5	320	400	510	10	23	100	1.5	3.5	325	Yellow	Contd.
ASF1310	Bi <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub> -PbO	520-20	54	4.9	345	450	-	-	-	-	5.5	8.7	100	Black	Contd.

## ASF Powder Glass for Mold

Code	Glass Type	Firing Condition Temp.-Time (°C-min)	Thermal Expansion Coeff. ( $\times 10^{-7}/^{\circ}\text{C}$ ) 25~300°C	Specific Gravity	Viscosity Property (DTA)			Electrical Property			Particle Property		Color (After Firing)	Lead Free or Contd.	
					Point (°C)	Softening Point (°C)	Temp. (°C)	Volume Resistance $\log \rho$ ( $\Omega \cdot \text{cm}$ ) 150°C	Dielectric Constant $\epsilon$ 1MHz, 25°C	Dielectric Loss $\tan \delta$ ( $\times 10^{-4}$ ) 1MHz, 25°C	Average Particle Size ( $\mu\text{m}$ )	Particle Size (Center Value) (D50) ( $\mu\text{m}$ )			Sieving Size Mesh Pass
ASF1400	Bi <sub>2</sub> O <sub>3</sub> -ZnO	690-5	48	3.9	545	640	-	14	8	30	7.3	18.4	100	White	Contd.
ASF1405	Bi <sub>2</sub> O <sub>3</sub> -ZnO	690-5	48	3.8	550	650	-	14	8	30	4.5	-	200	White	Contd.

● A low-alkali glass with excellent insulating properties and good sealing to silicon chips.

## ASF Powder Glass for Passivation

Code	Glass Type	Firing Condition Temp.-Time (°C-min)	Thermal Expansion Coeff. ( $\times 10^{-7}/^{\circ}\text{C}$ ) 25~300°C	Specific Gravity	Viscosity Property (DTA)			Electrical Property			Particle Property			Color (After Firing)	Lead Free or Contd.
					Transformation Point (°C)	Softening Point (°C)	Crystallization Temp. (°C)	Volume Resistance $\log \rho$ ( $\Omega \cdot \text{cm}$ ) 150°C	Dielectric Constant $\epsilon$ 1MHz, 25°C	Dielectric Loss $\tan \delta$ ( $\times 10^{-4}$ ) 1MHz, 25°C	Average Particle Size ( $\mu\text{m}$ )	Particle Size (Center Value) (D50) ( $\mu\text{m}$ )	Sieving Size Mesh Pass		
SF1260	SiO <sub>2</sub> -PbO	730-10	47	3.5	480	650	—	—	—	—	2.8	—	325	White	Contd.

● A low-alkali glass with excellent insulating properties and good sealing to silicon chips.

## ASF Powder Glass for Shadowmask Coating

Code	Glass Type	Firing Condition Temp.-Time (°C--min)	Thermal Expansion Coeff. (X10 <sup>-7</sup> /°C) 25~300°C	Specific Gravity	Viscosity Property (DTA)			Electrical Property			Particle Property			Color  (After Firing)	Lead Free or Contd.
					Point (°C)	Softening Point (°C)	Crystallization Temp. (°C)	Volume Resistance log ρ (Ω·cm)	Dielectric Constant ε	Dielectric Loss tan δ (X10 <sup>-4</sup> )	Average Particle Size (D50) (μm)	Particle Size (Center Value) (D50) (μm)	Sieving Size Mesh Pass		
ASF2002	Bi <sub>2</sub> O <sub>3</sub> -ZnO-PbO	440-35 80		6.5	320	400	-	12.5	40	400	4.0	-	150	Black	Contd.

● With a conductive filler additive, this frit makes it possible to control the static electrical characteristics of coated substances.

ASF Powder Glass for Binder (Lead Contd.)

Code	Glass Type	Firing Condition		Thermal Expansion Coeff. ( $\times 10^{-7}/^{\circ}\text{C}$ ) 25~300 $^{\circ}\text{C}$	Specific Gravity	Viscosity Property (DTA)			Electrical Property			Particle Property		Color (After Firing)	Lead Free or Contd.
		Temp.-Time	( $^{\circ}\text{C}$ -min)			Point ( $^{\circ}\text{C}$ )	Point ( $^{\circ}\text{C}$ )	Temp. ( $^{\circ}\text{C}$ )	Volume Resistance $\log \rho$ ( $\Omega \cdot \text{cm}$ ) 150 $^{\circ}\text{C}$	Dielectric Constant $\epsilon$ 1MHz, 25 $^{\circ}\text{C}$	Dielectric Loss $\tan \delta$ ( $\times 10^{-4}$ ) 1MHz, 25 $^{\circ}\text{C}$	Average Particle Size ( $\mu\text{m}$ )	Particle Size (D50) ( $\mu\text{m}$ )	Sieving Size (Mesh Pass)	
ASF1216	SiO <sub>2</sub> -PbO-Bi <sub>2</sub> O <sub>3</sub>	800-10	64	64	4.3	470	575		-	-	-	-	1.8	325	Contd.
ASF1217	SiO <sub>2</sub> -PbO-Bi <sub>2</sub> O <sub>3</sub>	800-10	55	55	4.1	470	595		-	-	-	-	2.0	325	Contd.
ASF1231	SiO <sub>2</sub> -PbO	850-15	73	73	4.5	460	600		-	-	-	2.0	-	325	Contd.
ASF1280	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -PbO	600-15	82	82	5.1	430	535	590	-	-	-	1.5	-	325	Contd.
ASF1280D	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -PbO	440-10	107	107	6.2	340	380		-	-	-	1.5	-	325	Contd.
ASF1281	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -PbO	440-10	106	106	6.4	335	400		-	-	-	4.5	-	325	Contd.
ASF1330	Bi <sub>2</sub> O <sub>3</sub> -PbO	500-15	92	92	5.8	380	445		13	14	21	2.0	3.9	325	Contd.
ASF1340	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -PbO	550-10	77	77	5.2	420	505		14	13	16	2.0	1.2	325	Contd.
ASF1350	Bi <sub>2</sub> O <sub>3</sub> -PbO	520-10	79	79	6.2	345	420	515	10	20	50	4.0	8.1	150	Contd.
ASF1370	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -PbO	850-15	54	54	3.8	465	615		14	8	10	2.1	2.2	325	Contd.
ASF1373	SiO <sub>2</sub> -PbO	700-15	83	83	4.1	555	695		-	-	-	2.0	2.4	325	Contd.
ASF1380	SiO <sub>2</sub> -PbO	810-5	92	92	3.8	555	700		-	-	-	2.0	1.5	325	Contd.
ASF1381	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -PbO	800-10	60	60	3.5	555	625	685	-	-	-	7.0	20.3	100	Contd.
ASF1460	Bi <sub>2</sub> O <sub>3</sub> -ZnO	720-10	39	39	3.9	530	600		-	-	-	4.8	10.7	250	Contd.
ASF1500	SiO <sub>2</sub> -Al <sub>2</sub> O <sub>3</sub> -RO	850-15	80	80	3.0	600	625	805	14	11	10	2.3	2.9	325	Contd.
ASF1508	SiO <sub>2</sub> -Al <sub>2</sub> O <sub>3</sub> -RO	800-15	63	63	3.9	610	685	705	-	-	-	1.7	1.9	325	Contd.
ASF1535	SiO <sub>2</sub> -ZnO-PbO	720-15	55	55	3.5	555	685		-	-	-	1.8	-	325	Contd.
ASF1540	SiO <sub>2</sub> -PbO-RO	850-10	52	52	3.1	615	770		-	-	-	1.8	2.1	325	Contd.
ASF1550	Bi <sub>2</sub> O <sub>3</sub> -ZnO-PbO	550-15	47	47	4.8	450	515	540	14	11	10	2.5	1.3	325	Contd.
ASF1590	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -PbO	750-10	59	59	3.6	530	660		-	-	-	4.5	-	100	Contd.
ASF1592	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -PbO	850-10	50	50	3.6	575	750	945	-	-	-	1.3	-	325	Contd.

ASF Powder Glass for Binder (Lead Free.)

Code	Glass Type	Firing Condition		Thermal Expansion Coeff. ( $\times 10^{-7}/^{\circ}\text{C}$ ) 25~300 $^{\circ}\text{C}$	Specific Gravity	Viscosity Property (DTA)			Electrical Property			Particle Property		Color (After Firing)	Lead Free or Contd.
		Temp.-Time	( $^{\circ}\text{C}$ -min)			Point ( $^{\circ}\text{C}$ )	Point ( $^{\circ}\text{C}$ )	Temp. ( $^{\circ}\text{C}$ )	Volume Resistance $\log \rho$ ( $\Omega \cdot \text{cm}$ ) 150 $^{\circ}\text{C}$	Dielectric Constant $\epsilon$ 1MHz, 25 $^{\circ}\text{C}$	Dielectric Loss $\tan \delta$ ( $\times 10^{-4}$ ) 1MHz, 25 $^{\circ}\text{C}$	Average Particle Size ( $\mu\text{m}$ )	Particle Size (D50) ( $\mu\text{m}$ )	Sieving Size (Mesh Pass)	
ASF1100	Bi <sub>2</sub> O <sub>3</sub> -Bi <sub>2</sub> O <sub>3</sub>	460-30	113	113	6.4	380	440		-	-	-	-	5.2	150	Free
ASF1100B	Bi <sub>2</sub> O <sub>3</sub> -Bi <sub>2</sub> O <sub>3</sub>	460-30	107	107	6.3	360	460	520	-	-	-	-	1.1	325	Free
ASF1108	Bi <sub>2</sub> O <sub>3</sub> -ZnO-Bi <sub>2</sub> O <sub>3</sub>	580-5	65	65	5.1	460	540		-	-	-	-	2.8	325	Free
ASF1131	Bi <sub>2</sub> O <sub>3</sub> -ZnO-Bi <sub>2</sub> O <sub>3</sub>	800-5	88	88	4.1	440	554		-	-	-	-	3.3	325	Free
ASF1495	Bi <sub>2</sub> O <sub>3</sub> -ZnO	800-15	55	55	3.7	505	595	845	-	-	-	1.8	2.2	325	Free
ASF1560	SiO <sub>2</sub> -ZnO-RO	850-15	73	73	3.3	870	770	810	-	-	-	1.7	1.8	325	Free
ASF1561	SiO <sub>2</sub> -ZnO-RO	850-10	73	73	3.4	845	753	900	-	-	-	-	3.9	325	Free
ASF1700	SiO <sub>2</sub> -ZnO-RO	850-15	72	72	3.7	655	805	885	14	9	20	1.6	1.6	325	Free
ASF1710	SiO <sub>2</sub> -Al <sub>2</sub> O <sub>3</sub> -RO	850-15	80	80	3.1	720	880	915	14	9	20	1.1	1.5	325	Free
ASF1771	SiO <sub>2</sub> -ZnO-RO	1050-15	65	65	2.7	670	805		-	-	-	6.0	14.9	100	Free
ASF1780	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -RO	850-15	52	52	2.5	535	780		-	-	-	3.0	3.8	325	Free
ASF1800	SiO <sub>2</sub> -ZnO-RO	900-60	61	61	3.3	640	795		-	-	-	1.9	-	325	Free
ASF1881	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -ZnO	800-10	68	68	3.5	480	580	715	-	-	-	-	3.0	325	Free
ASF1891F	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -ZnO	810-10	63	63	3.5	485	580	690	-	-	-	-	1.5	325	Free
ASF1893AB	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -ZnO	800-10	64	64	3.2	460	560	800	-	-	-	-	4.0	325	Free
ASF1895	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -RO	800-10	85	85	3.6	480	570		-	-	-	-	1.5	325	Free
ASF1898	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -RO	800-10	108	108	3.4	440	525		-	-	-	-	4.5	200	Free
ASF1898B	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -RO	800-10	106	106	3.4	438	525		-	-	-	-	1.1	200	Free
ASF1939	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -RO	850-15	87	87	3.7	620	720		-	-	-	-	2.0	325	Free
ASF1941	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -RO	700-15	90	90	3.7	590	680		-	-	-	-	3.5	100	Free
ASF1941B	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -RO	700-15	90	90	3.7	585	673		-	-	-	-	1.2	325	Free
ASF1980	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -RO	600-10	104	104	2.6	440	560		-	-	-	-	4.0	100	Free
ASF1980B	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -RO	600-10	104	104	2.6	450	570		-	-	-	-	1.4	325	Free

1098	Bi <sub>2</sub> O <sub>3</sub> -ZnO-Bi <sub>2</sub> O <sub>3</sub>	600-10	54	54	5.5	440	520	550	-	-	-	-	3.0	100	Free
1099	Bi <sub>2</sub> O <sub>3</sub> -ZnO-Bi <sub>2</sub> O <sub>3</sub>	600-10	43	43	4.7	480	480	570	-	-	-	-	3.5	100	Free
ASF1620M	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -ZnO	850-15	50	50	3.7	560	657	810	-	-	-	-	25.0	150	Free
1991	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -RO	600-10	160	160	2.8	395	505		-	-	-	-	8.0	150	Free
R273	SiO <sub>2</sub> -RO	1000-30	74	74	3.0	730	880		-	-	-	-	8.0	100	Free
C153M	SiO <sub>2</sub> -ZnO-RO	950-10	109	109	3.8	670	800	910	-	-	-	-	2.5	325	Free

Characteristics

●Widely used as a binder for electrodes and resistors in thick-film printed circuits.

●We can supply other grades and specifications of glass ( grain diam., etc. ) on both a prototype and a mass-production basis.

●Available as paste.

## ASF Powder Glass for Glass-Ceramic Multilayer Substrate

Code	Glass Type	Firing Condition Temp. - Time (°C - min)	Thermal Expansion Coeff. (X10 <sup>-7</sup> /°C) 25 ~ 300°C	Specific Gravity	Viscosity Property (DTA)			Electrical Property			Particle Property			Color (After Firing)	Thermal Conductivity (X10 <sup>-3</sup> cal/cm·sec·°C)	Lead Free or Contd.
					Point (°C)	Point (°C)	Temp. (°C)	Crystallization	Volume Resistance log ρ (Ω·cm) 150°C	Dielectric Constant ε 1MHz, 25°C	Dielectric Loss tan δ (X10 <sup>-4</sup> ) 1MHz, 25°C	Average Particle Size (μm)	Particle Size (Center Value) (D50) (μm)			
ASF1780	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -RO	900-60	52	2.5	535	780	-	-	-	-	3.0	3.8	325	Clear	-	Free
ASF1781	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -RO	900-10	32	2.2	835	930	-	-	4	8	-	2.8	325	White	-	Free
ASF102M	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -R <sub>2</sub> O	900-60	28	2.2	495 <sup>*1</sup>	800	-	14	4	-	-	3.5	-	Clear	-	Free
ASF102Y	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -R <sub>2</sub> O	850-10	28	2.2	495 <sup>*1</sup>	775	-	-	-	-	-	1.3	-	Clear	-	Free
ASF102X	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -R <sub>2</sub> O	850-10	27	2.2	500 <sup>*1</sup>	760	-	-	-	-	-	1.0	-	Clear	-	Free
ASF102W	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -R <sub>2</sub> O	850-10	27	2.2	512 <sup>*1</sup>	755	-	-	-	-	-	0.8	-	Clear	-	Free
ASF1880	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -R <sub>2</sub> O	900-60	37	2.7	550	785	-	14	5	-	-	2.6	-	Clear	2.2	Free
ASF0325V	SiO <sub>2</sub> -Al <sub>2</sub> O <sub>3</sub> -MgO	900-60	2.7	-	-	830	980,990	-	-	-	-	2.0	-	Clear	-	Free
ASF0325C	SiO <sub>2</sub> -Al <sub>2</sub> O <sub>3</sub> -MgO	-	15	2.7	-	-	-	-	-	-	-	2.0	-	White	-	Free

Characteristics

● These are the low dielectric constant borosilicate glass suitable for the thermal expansion coefficient of silicon chips.

● ASF0325V and ASF0325C are cordierite.

● Powder glass with controlled water content and grain-size distribution for green sheeting.

● We can supply other grades and specifications of glass (grain diam., etc.) on both a prototype and a mass-production basis.

● Can be blended with alumina, cordierite and other ceramic powders.

\*1 : Transformation point of TMA curve.

## ASF Powder Glass for Alumina Substrate Glazing

Code	Glass Type	Firing Condition Temp.-Time	Thermal Expansion Coeff. ( $\times 10^{-7}/^{\circ}\text{C}$ ) 25~300°C	Viscosity Property (DTA)			Electrical Property			Particle Property			Color (After Firing)	Thermal Conductivity ( $\times 10^{-3}\text{cal/cm}\cdot\text{sec}\cdot^{\circ}\text{C}$ )	Lead Free or Contd.
				Transformation Point ( $^{\circ}\text{C}$ )	Softening Point ( $^{\circ}\text{C}$ )	Crystallization Temp. ( $^{\circ}\text{C}$ )	Volume Resistance $\log \rho$ ( $\Omega\cdot\text{cm}$ ) 150°C	Dielectric Constant $\epsilon$ 1MHz, 25°C	Dielectric Loss $\tan \delta$ ( $\times 10^{-4}$ ) 1MHz, 25°C	Average Particle Size ( $\mu\text{m}$ )	Particle Size (Center Value) (D50) ( $\mu\text{m}$ )	Sieving Size Mesh Pass			
ASF1761	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -RO	1250-60	69	710	870	—	—	—	—	—	5.2	325	Clear	2.0	Free
ASF1762	SiO <sub>2</sub> -RO	1250-60	65	765	925	—	—	—	—	—	5.0	325	Clear	2.0	Free

## ATG Powder Glass for CRT, VFD, PDP sealing

Code	Type of Glass			Sealing temperature and time			Characteristics of Glass										Lead Free or Contd.	Other	
	Glass Characteristics	Composition	Color	Shape	Sealing Temp. (°C)	Sealing Time (min)	Major application	Thermal Expansion X10 <sup>-7</sup> /°C	Transition Point (°C)	Softening Point (°C)	Density	Volume Resistance log 10R at 250°C	Dielectric Constant	Young's Modulus GPa	Bending Strength MPa	Sieving Size Mesh			Pass
IWF-DT430	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub>	Black	Powder,Pre-formed	430	10	VFD-PDP	72	30-300	310	353 <sup>41</sup>	7.2	9.8	35.0	57	57	100	Contd.	Soda-Lime Glass Sealing
IWF-DT430-150	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub>	Black	Powder,Pre-formed	430	10	VFD-PDP	72	30-300	310	353 <sup>41</sup>	7.2	9.8	35.0	57	57	150	Contd.	Soda-Lime Glass Sealing
IWF-T029	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub>	White	Powder,Pre-formed	450	15	VFD	78	30-300	316	365 <sup>41</sup>	6.0	9.2	20.0	40	49	100	Contd.	
IWF-7590B	devitrifying	PbO-Bi <sub>2</sub> O <sub>3</sub> -ZnO	Black	Powder,Pre-formed	440	35	CRT	89	30-300	320	370 <sup>41</sup>	6.4	10.1	21.0	57	49	100	Contd.	
IWF-7575BF	devitrifying	PbO-Bi <sub>2</sub> O <sub>3</sub> -ZnO	Black	Powder,Pre-formed	450	40	VFD	89	30-300	320	375 <sup>41</sup>	6.4	8.5	19.0	51	41	100	Contd.	
IWF-T759	devitrifying	PbO-Bi <sub>2</sub> O <sub>3</sub> -ZnO	Black	Powder,Pre-formed	430	30	VFD	82	30-300	310	355 <sup>41</sup>	6.1					100	Contd.	
IWF-2300M	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub>	Black	Powder,Pre-formed	430	10	PDP	67	30-250	307	360 <sup>41</sup>	7.2	9.8	35.0	57	57	150	Contd.	PD200 Sealing
MFP2005	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub>	Black	Powder	470	10	PDP	67	30-250	347	419 <sup>41</sup>	6.5					150	Contd.	
MFP2014	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub>	Black	Powder	480	10	PDP	68	30-250	341	433 <sup>41</sup>	6.8					150	Contd.	

\*1 Third inflection point on DTA curve

## ATG Powder Glass for Ceramic sealing, Additives to Ceramic substrates

Code	Type of Glass			Sealing temperature and time		Characteristics of Glass										Lead Free or Contd.	Other		
	Glass Characteristics	Composition	Color	Shape	Sealing Temp. (°C)	Sealing Time (min)	Major application	Thermal Expansion X10 <sup>-7</sup> /°C Range(°C)	Transition Point (°C)	Softening Point (°C)	Density	Volume Resistance log 10R at250°C	Dielectric Constant R.T.1MHz	Young's Modulus GPa	Bending Strength MPa			Sieving Size Mesh	
WVF-T187M	Vitreous	2004April version	Black	Powder,Pre-formed	430	10	IC package	65	30-300	308	351 <sup>41</sup>	5.6	9.4	12.8	71	81	150	Contd.	Alumina Sealing
RWF-C7410	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub>	Black	Powder,Pre-formed	410	10	IC package	69	30-280	288	337 <sup>41</sup>	5.6	9.5	12.7	69	69	150	Contd.	Alumina Sealing
RWF-7583BF	devitrifying	PbO-Bi <sub>2</sub> O <sub>3</sub> -ZnO	Black	Powder,Pre-formed	500	5	IC package	84	30-300	325	370 <sup>41</sup>	6.1	8.3	18.9	42	52	150	Contd.	
WVF-T072	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub>	White	Powder,Pre-formed	575	5	Insulation, Over coating	68	30-400	449	521 <sup>41</sup>	4.3	12.3	13.0	47	59	100	Contd.	
WVF-T077	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub> -Al <sub>2</sub> O <sub>3</sub>	White	Powder,Pre-formed	530	5	Insulation, Over coating	74	30-300	411	475 <sup>41</sup>	5.0	11.2	20.1	45	53	100	Contd.	
WVF-7578W	devitrifying	PbO-Bi <sub>2</sub> O <sub>3</sub> -ZnO	White	Powder,Pre-formed	520	60	Insulation, Over coating	76	30-300	385	440 <sup>41</sup>	6.2	12.0	18.3	59	49	100	Contd.	
RWF-7574	devitrifying	ZnO-Bi <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub>	White	Powder,Pre-formed	750	30	AIN Sealing	37	30-500	560	640 <sup>41</sup>	3.6	13.7	6.1	62	69	100	Free	
K807	Vitreous	SiO <sub>2</sub> -BaO-Bi <sub>2</sub> O <sub>3</sub>	White	Powder			Ceramic co-firing	77	30-300	638	725 <sup>41</sup>	3.6		7.1			100	Free	
K808	Vitreous	SiO <sub>2</sub> -BaO-Bi <sub>2</sub> O <sub>3</sub>	White	Powder			Ceramic co-firing	69	30-300	630	725 <sup>41</sup>	3.4		6.9			100	Free	
K806	devitrifying	SiO <sub>2</sub> -BaO-Al <sub>2</sub> O <sub>3</sub>	White	Powder			Ceramic co-firing	93	30-300	690	780 <sup>41</sup>	3.8		9.7			300	Free	Devitrifying Temp. : 870°C
LS-5	devitrifying	SiO <sub>2</sub> -BaO-Li <sub>2</sub> O	White	Powder			Dielectric	108	30-300	478	553 <sup>41</sup>	2.9					300	Free	Devitrifying Temp. : 775°C
K905	Vitreous	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -Al <sub>2</sub> O <sub>3</sub>	White	Powder			LTCC	25	30-300	520	750 <sup>41</sup>	2.2	10.0	4.3			300	Free	
FF201	Vitreous	SiO <sub>2</sub> -MgO-Al <sub>2</sub> O <sub>3</sub>	White	Powder			LTCC	52	30-300	720	820 <sup>41</sup>	2.6		6.0			300	Free	Devitrifying Temp. : 1000°C
1724	Vitreous	SiO <sub>2</sub> -BaO-Al <sub>2</sub> O <sub>3</sub>	White	Powder			Insulation, Over coating	44	0-300	726	924 <sup>41</sup>	2.6		8.8			300	Free	Strain Point : 674°C
GSP523	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub> -ZnO	White	Powder	580	30	Paste	86	50-300	370	448 <sup>41</sup>	5.4					300	Contd.	Deformation Point : 410°C
GSP553	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub>	White	Powder	800	20	Condenser paste	54	0-300	550	703 <sup>41</sup>	2.5					300	Free	Deformation Point : 630°C
SK-231	Vitreous	Bi <sub>2</sub> O <sub>3</sub> -Bi <sub>2</sub> O <sub>3</sub>	White	Powder,Pre-formed	575	20	Paste	84	30-300	485	560 <sup>41</sup>	5.1	11.7	17.0	78		300	Free	
SK-360	Vitreous	Li <sub>2</sub> O-ZnO	White	Powder,Pre-formed	580	30	Paste	67	30-300	465	549 <sup>41</sup>	3.8	8.1	9.0	89		300	Free	
2431	Vitreous	SnO-ZnO-PbO <sub>3</sub>	Pale brown	Powder	480	10	Paste	137	25-300	280		2.8					100	Free	
2432	Vitreous	SnO-ZnO-PbO <sub>3</sub>	Black	Powder	480	10	Paste	82	50-250	350		3.9					100	Free	
K301	devitrifying	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -BaO	White	Powder			Dielectric	88	30-300	556	586 <sup>41</sup>	2.9					300	Free	Devitrifying Temp. : 760°C
K303	devitrifying	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -BaO	White	Powder			Dielectric	135	30-300	370	400 <sup>41</sup>	3.1					300	Free	Devitrifying Temp. : 690°C
K304	devitrifying	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -BaO	White	Powder			Dielectric	112	30-300	440	478 <sup>41</sup>	2.8					300	Free	Devitrifying Temp. : 810°C
K804	devitrifying	Bi <sub>2</sub> O <sub>3</sub> -BaO-ZnO	White	Powder			LTCC	80	30-300	500	580 <sup>41</sup>	4.0					300	Free	Devitrifying Temp. : 820°C
K835	devitrifying	Bi <sub>2</sub> O <sub>3</sub> -ZnO	White	Powder			LTCC	43	30-300	529	603 <sup>41</sup>	3.6					300	Free	Devitrifying Temp. : 854°C
K836	devitrifying	SiO <sub>2</sub> -BaO-TiO <sub>2</sub>	White	Powder			Dielectric	93	30-300	693	757 <sup>41</sup>	4.1					300	Free	Devitrifying Temp. : 830°C
K837	devitrifying	BiO <sub>3</sub> -MgO-TiO <sub>2</sub>	White	Powder			Dielectric	90	30-300	608	712 <sup>41</sup>	2.3					300	Free	Devitrifying Temp. : 733°C
J501	Vitreous	SiO <sub>2</sub> -Al <sub>2</sub> O <sub>3</sub> -RO	White	Powder			Dielectric	41	30-300	760	900 <sup>41</sup>	2.6					200	Free	
FF209	devitrifying	SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -BaO	White	Powder			Paste	121	30-300	400	450 <sup>41</sup>	2.8	9.8				300	Free	Devitrifying Temp. : 590°C
FF202	devitrifying	SiO <sub>2</sub> -Al <sub>2</sub> O <sub>3</sub> -RO	White	Powder	900	30	LTCC	112	30-300	690	760 <sup>41</sup>	3.3					300	Free	Devitrifying Temp. : 900°C
FF203	devitrifying	SiO <sub>2</sub> -Al <sub>2</sub> O <sub>3</sub> -RO	White	Powder	800	30	LTCC	100	30-300	700	775 <sup>41</sup>	3.4					300	Free	Devitrifying Temp. : 890°C

\*1 Third inflection point on DTA curve

\*2 Fiber method



## ATG Powder Glass for Metal Sealing (Stainless steel, Kovar, Ferrite)

Code	Type of Glass			Sealing temperature and time		Characteristics of Glass										Lead Free or Contd.	Other	
	Glass Characteristics	Composition	Color	Shape	Sealing Temp. (°C)	Sealing Time (min)	Major application	Thermal Expansion X10 <sup>-1</sup> /°C	Transition Point (°C)	Softening Point (°C)	Density	Volume Resistance log 10R at250°C	Dielectric Constant R.T.1MHz	Young's Modulus GPa	Bending Strength MPa			Sieving Size Mesh Pass
IRW-7570	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub> -Al <sub>2</sub> O <sub>3</sub>	White	Powder,Pre-formed	500	5	Seathed heaters	84	30-300	378	440 <sup>1)</sup>	5.4	15.6	44	42	100	Contd.	
	Vitreous	IRW-T214 PbO-SiO <sub>2</sub>	White	Powder,Pre-formed	500	10	Seathed heaters	125	30-300	358	435 <sup>1)</sup>	4.7	10.4	15.6	43	44	100	Contd.
	Vitreous	IRW-T015 PbO-Bi <sub>2</sub> O <sub>3</sub>	White	Powder,Pre-formed	425	5	Seathed heaters	110	30-300	316	385 <sup>1)</sup>	6.4	8.8	22.2	39	35	100	Contd.
	Vitreous	KF1729 PbO-SiO <sub>2</sub>	Black	Powder,Pre-formed	800	10	Ferrites Sealing	88	30-300	430	555 <sup>1)</sup>	4.4					100	Contd.
	Vitreous	KF2475 PbO-SiO <sub>2</sub>	Black	Powder,Pre-formed	560	10	Ferrites Sealing	101	30-300	378	485 <sup>1)</sup>	5.5					100	Contd.
	Vitreous	KF1730 PbO-Bi <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub>	Black	Powder,Pre-formed	520	10	Ferrites Sealing	87	30-300	348	418 <sup>1)</sup>	6.2					100	Contd.
	Vitreous	AF103 PbO-Bi <sub>2</sub> O <sub>3</sub>	White	Powder,Pre-formed	400	10	Stainless Steel Sealing	118	30-280	285	340 <sup>1)</sup>	6.8					100	Contd.
	Vitreous	IRW-T438 PbO-Bi <sub>2</sub> O <sub>3</sub>	Black	Powder,Pre-formed	450	10	Kovar Sealing	60	30-300	308	348 <sup>1)</sup>	7.2	9.8	40.0	63	57	150	Contd.
	Vitreous	K9002D SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -Na <sub>2</sub> O	White	Powder,Pre-formed	1000	10	Kovar Sealing	47	0-300	510	728 <sup>2)</sup>	2.3					100	Free
	Vitreous	K9104 SiO <sub>2</sub> -Bi <sub>2</sub> O <sub>3</sub> -Na <sub>2</sub> O	White	Powder	1000	10	Kovar Sealing	54	0-300	490	715 <sup>2)</sup>	2.2					100	Free
GSP507C	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub>	White	Powder,Pre-formed	450	10	Seathed heaters	113	50-250	310	355 <sup>1)</sup>	6.5	9.0		54	55	100	Free
	Vitreous	PbO-Bi <sub>2</sub> O <sub>3</sub>	Black	Powder	550	30	Ferrites Sealing	100	50-250	340	397 <sup>1)</sup>	6.2					—	Contd.
	Vitreous	GSP535 PbO-Bi <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub>	White	Powder	550	30	Ferrites Sealing	85	50-300	410	468 <sup>1)</sup>	6.0					—	Contd.
	Vitreous	GSP507 PbO-Bi <sub>2</sub> O <sub>3</sub>	White	Powder	450	10	Carbon Brush	112	50-250	310	354 <sup>1)</sup>	6.6					300	Contd.

\*1 Third inflection point on DTA curve

\*2 Fiber method

## ATG "Lead Free" Powder Glass for Low Temperature Sealing

Code	Type of Glass			Sealing temperature and time		Characteristics of Glass										Lead Free or Contd.	Other	
	Glass Characteristics	Composition	Color	Shape	Sealing Temp. (°C)	Sealing Time (min)	Major application	Thermal Expansion $\times 10^{-7}/^{\circ}\text{C}$	Transition Point (°C)	Softening Point (°C)	Density	Volume Resistance $\log 10R$ at 250°C	Dielectric Constant R.T. 1MHz	Young's Modulus GPa	Bending Strength MPa			Sieving Size Mesh Pass
FP-74 <sup>1)</sup>	Vitreous	SnO·PbO <sub>5</sub>	Gray	Powder	480	10	Ceramic (Alumina) Sealing	84	30-250	281	355 <sup>1)</sup>	3.4	—	—	—	—	150	Free
FP-67 <sup>1)</sup>	Vitreous	SnO·PbO <sub>5</sub>	Gray	Powder	480	10	Soda-Lime Glass Sealing	81	30-250	280	345 <sup>1)</sup>	3.4	—	—	—	—	150	Free
KF9531 <sup>1)</sup>	Vitreous	SnO·PbO <sub>5</sub>	White	Powder	400	10		140	30-250	284	308 <sup>1)</sup>	4.1	—	—	—	—	150	Free
KF9079 <sup>1)</sup>	Vitreous	SnO·PbO <sub>5</sub>	White	Powder	480	10		122	30-250	280	338 <sup>1)</sup>	3.8	—	—	—	—	150	Free

\*1 Licensed product of U.S. Patent No.5281860. Could not be used for some application. Please contact us for further information.

\*2 Third inflection point on DTA curve

## AP Overcoat Glass Paste for Hybrid IC

Code	Glass Type	Paste and Fired Glass Feature	Glass Characteristics	Paste Viscosity (Pa·s)	Paste Specific Gravity	Firing Condition (°C-min.)	Thermal Expansion Coeff. (X10 <sup>-6</sup> /°C)	Viscosity Property (DTA)			Color	Electrical Property			Particle Property		Lead Free or Contd.
								Transform- mation Point (°C)	Softening Point (°C)	Crystallization Temp. (°C)		Insulation Resistance (Ω)	Breakdown Voltage (V)	tan δ (%)	Average Particle Size (μm)	Sieving Size Mesh Pass	
AP5346	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -PbO	Excellent waterproofing	Vitreous	170	2.4	510-5	72	400	485		Paste Fired Glass	>10 <sup>10</sup>	>500	8~12	<0.3	325	Contd.
AP5346B	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -PbO	Excellent waterproofing	Vitreous	185	2.4	510-5	72	400	485		Green Black	>10 <sup>10</sup>	>500	8~12	<0.3	325	Contd.
AP5346G	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -PbO	For solder dams	Vitreous	300	2.4	510-5	72	400	485		Green	>10 <sup>10</sup>	>500	8~12	<0.3	325	Contd.
AP5346W	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -PbO	Excellent waterproofing	Vitreous	150	2.4	510-5	72	400	485		White	>10 <sup>10</sup>	>500	8~12	<0.3	325	Contd.
AP5530	SiO <sub>2</sub> -ZnO-PbO	High mechanical strength	Crystalline	150	2.8	550-5	47	455		540	White	>10 <sup>10</sup>	>500	7~12	<0.3	325	Contd.
AP5531	SiO <sub>2</sub> -ZnO-PbO	High mechanical strength	Crystalline	150	2.8	550-5	47	455		540	Green	>10 <sup>10</sup>	>500	7~12	<0.3	325	Contd.

## AP Dielectric Crossover Paste for Hybrid IC

Code	Glass Type	Paste and Fired Glass Feature	Glass Characteristics	Paste Viscosity (Pa·s)	Paste Specific Gravity	Firing Condition (°C-min.)	Thermal Expansion Coeff. (X10 <sup>-6</sup> /°C)	Viscosity Property (DTA)			Color	Electrical Property			Particle Property		Lead Free or Contd.
								Transform- mation Point (°C)	Softening Point (°C)	Crystallization Temp. (°C)		Insulation Resistance (Ω)	Breakdown Voltage (V)	tan δ (%)	Average Particle Size (μm)	Sieving Size Mesh Pass	
AP5455A	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -RO	High density	Vitreous	180	-	800-10	105	500	820		Paste Fired Glass	>10 <sup>10</sup>	>800	10~15	<0.3	100	Free
AP5508	SiO <sub>2</sub> -ZnO-PbO	High density	Crystalline	170	-	800-10	63	615	705	780	Blue	>10 <sup>10</sup>	>800	10~15	<0.3	325	Contd.
AP5506B	SiO <sub>2</sub> -ZnO-PbO	High density	Crystalline	170	-	800-10	63	615	705	780	Black	>10 <sup>10</sup>	>800	10~15	<0.3	325	Contd.
AP5578	SiO <sub>2</sub> -ZnO-RO	High density High breakdown voltage	Crystalline	170	1.9	850-10	53	670	785	830	Orange	>10 <sup>10</sup>	>1000	9~14	<0.2	325	Free
AP5578VE	SiO <sub>2</sub> -ZnO-RO	Excellent printing. High density High breakdown voltage	Crystalline	190	1.9	850-10	53	670	785	830	Orange	>10 <sup>10</sup>	>1000	9~14	<0.2	325	Free
AP5577	SiO <sub>2</sub> -ZnO-RO	High density	Crystalline	170	1.9	850-10	53	670	785	830	Blue	>10 <sup>10</sup>	>800	9~14	<0.3	325	Free
AP5578	SiO <sub>2</sub> -ZnO-RO	2004 April version	Crystalline	170	1.9	850-10	53	670	785	830	Black	>10 <sup>10</sup>	>800	11~16	<0.4	325	Free

## AP Dielectric Paste for Multilayer Hybrid IC

Code	Glass Type	Paste and Fired Glass Feature	Glass Characteristics	Paste Viscosity (Pa·s)	Paste Specific Gravity	Firing Condition (°C-min.)	Thermal Expansion Coeff. (X10 <sup>-6</sup> /°C)	Viscosity Property (DTA)			Color	Electrical Property			Particle Property		Lead Free or Contd.
								Transform- mation Point (°C)	Softening Point (°C)	Crystallization Temp. (°C)		Insulation Resistance (Ω)	Breakdown Voltage (V)	tan δ (%)	Average Particle Size (μm)	Sieving Size Mesh Pass	
AP5700C	SiO <sub>2</sub> -ZnO-RO	High density	Partially	200	2.2	850-10	70	660	805	880	Orange	>10 <sup>10</sup>	>1000	8~14	<0.2	325	Free
AP5701C	SiO <sub>2</sub> -ZnO-RO	High density High breakdown voltage	Partially	190	2.2	850-10	70	660	805	880	Blue	>10 <sup>10</sup>	>1000	8~12	<0.2	325	Free
AP5707	SiO <sub>2</sub> -ZnO-RO	Minimal warping. High density. High breakdown voltage	Partially	160	2.2	850-10	75	665		900	Orange	>10 <sup>10</sup>	>1000	8~12	-	2.5	Free

AP Overcoat Glass Paste for Hybrid IC (Firing in N<sub>2</sub>)

Code	Glass Type	Paste and Fired Glass Feature	Glass Characteristics	Paste Viscosity (Pa·s)	Paste Specific Gravity	Firing Condition (°C-min.)	Thermal Expansion Coeff. (X10 <sup>-6</sup> /°C)	Viscosity Property (DTA)			Color	Electrical Property			Particle Property		Lead Free or Contd.
								Transform- mation Point (°C)	Softening Point (°C)	Crystallization Temp. (°C)		Insulation Resistance (Ω)	Breakdown Voltage (V)	tan δ (%)	Average Particle Size (μm)	Sieving Size Mesh Pass	
AP5840N	SiO <sub>2</sub> -PbO	Excellent waterproofing. Excellent resolution	Vitreous	80	-	550-5	63	480	550		Green	-	-	-	2.1	325	Contd.
AP5841	SiO <sub>2</sub> -PbO	Excellent waterproofing Excellent burn-out	Vitreous	50	-	600-5	80	450	585		Green	-	-	-	-	4.3	Contd.

AP Dielectric Crossover Paste for Hybrid IC (Firing in N<sub>2</sub>)

Code	Glass Type	Paste and Fired Glass Feature	Glass Characteristics	Paste Viscosity (Pa·s)	Paste Specific Gravity	Firing Condition (°C-min.)	Thermal Expansion Coeff. (X10 <sup>-6</sup> /°C)	Viscosity Property (DTA)			Color	Electrical Property			Particle Property		Lead Free or Contd.
								Transform- mation Point (°C)	Softening Point (°C)	Crystallization Temp. (°C)		Insulation Resistance (Ω)	Breakdown Voltage (V)	tan δ (%)	Average Particle Size (μm)	Sieving Size Mesh Pass	
AP5815C	SiO <sub>2</sub> -Al <sub>2</sub> O <sub>3</sub> -RO	High density High breakdown voltage	Partially	190	2.0	900-10	63	665	885		Blue	>10 <sup>10</sup>	>1000	7~12	<0.7	325	Contd.

## AP Dielectric Paste for Alumina Substrate Glazing of Print Head

Code	Glass Type	Paste and Fired Glass Feature	Glass Characteristics	Paste Viscosity (Pa·s)	Paste Specific Gravity	Firing Condition (°C—min.)	Thermal Expansion Coeff. (X10 <sup>-7</sup> /°C)	Viscosity Property (DTA)		Color	Electrical Property		Particle Property		Thermal Conductivity (X10 <sup>-3</sup> cal/cm·sec·°C)	Lead Free or Contd.				
								Transfer Point (°C)	Softening Point (°C)		Insulation Resistance (Ω)	Breakdown Voltage (V)	tan δ (%)	Average Particle Size (μm)			Particle Size (Center Value) (μm)	Sieving Size Mesh	Pass	
AP5710	SiO <sub>2</sub> -Al <sub>2</sub> O <sub>3</sub> -RO	High density	Crystalline	170	2.2	900—950—10	79	725	880	915	Orange	White	>10 <sup>11</sup>	>1000	8—12	<0.2	1.1	—	325	Free
AP5781D	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -RO	Excellent thermal conductivity	Vitreous	170	1.8	1200—1250—30—60	71	710	870	870	Orange	Clear	>10 <sup>11</sup>	>1000	—	—	—	5.0	325	Free
AP5782D	SiO <sub>2</sub> -RO	For overall glaze	Vitreous	170	1.8	1200—1250—30—60	67	765	925	925	Blue	Clear	>10 <sup>11</sup>	>1000	—	—	—	5.0	325	Free
AP5783D	SiO <sub>2</sub> -RO	For partial glaze	Vitreous	170	1.8	1200—1250—30—60	67	765	925	925	Blue	Clear	>10 <sup>11</sup>	>1000	—	—	—	5.0	325	Free

Characteristics  
 ● By controlling crystalline refraction, a smooth-surface glaze can be formed. (AP5781D, AP5782D)

## AP Overcoat Glass Paste for Print Head

Code	Glass Type	Paste and Fired Glass Feature	Glass Characteristics	Paste Viscosity (Pa·s)	Paste Specific Gravity	Firing Condition (°C-min.)	Thermal Expansion Coeff. (X10 <sup>-7</sup> /°C)	Viscosity Property (DTA)		Color		Electrical Property		Particle Property		Thermal Conductivity (X10 <sup>-3</sup> cal/cm <sup>2</sup> ·sec <sup>-1</sup> ·°C)	Lead Free or Contd.
								Transfer-mission Point (°C)	Crystallization Temp. (°C)	Paste	Fired Glass	Insulation Resistance (Ω)	Breakdown Voltage (V)	ε	tan δ (%)		
AP5317*	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -RO	Excellent surface flatness	Vitreous	80	2.4	850-10	55	580	720	Gray	Gray	-	-	-	1.5	325	Free
AP5347	PbO-B <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub>	Excellent surface flatness	Vitreous	120	2.4	810-10	70	475	590	White	Clear	-	-	-	-	325	Contd.
AP5348	PbO-B <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub>	High breakdown voltage	Vitreous	100	2.4	810-10	62	460	600	Gray	Black	>10 <sup>12</sup>	>2000	-	1.0	325	Contd.
AP5349	PbO-B <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub>	Excellent surface flatness	Vitreous	100	2.4	810-10	62	460	600	Gray	Gray	>10 <sup>12</sup>	>2000	-	1.0	325	Contd.
AP5352B	PbO-B <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub>	Excellent light blocking	Vitreous	100	2.4	810-10	65	460	580	Black	Black	-	-	-	1.0	325	Contd.
AP5384	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -PbO	Excellent resistance to wear	Vitreous	30	1.9	790-10	45	485	710	White	Clear	>10 <sup>14</sup>	>1000	8~13	<0.2	1.7	3.3
AP5588	SiO <sub>2</sub> -PbO	Excellent alkali resistance	Vitreous	50	2.2	830-10	57	570	770	White	Clear	>10 <sup>14</sup>	>1000	8~13	<0.2	1.5	3.3
AP5584F	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -PbO	Excellent surface flatness	Vitreous	70	2.1	810-10	51	515	680	White	Clear	>10 <sup>14</sup>	>1000	8~13	<0.2	0.8	3.3
AP5585F2	SiO <sub>2</sub> -PbO	Excellent surface flatness	Vitreous	70	2.4	830-10	58	535	745	White	Clear	>10 <sup>14</sup>	>1000	8~13	<0.2	0.7	3.5
AP5588	SiO <sub>2</sub> -PbO	Excellent resistance to wear	Vitreous	90	2.4	830-10	58	560	780	White	Clear	>10 <sup>14</sup>	>1000	8~13	<0.2	1.2	4.0
AP5717*	SiO <sub>2</sub> -ZnO-RO	For AIN coat	Crystalline	150	-	850-10	35	660	795	White	White	-	-	-	2.5	325	Free
AP5318	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -RO	High breakdown voltage	Vitreous	90	-	810-10	55	580	720	Gray	Gray	-	>1500	-	1.5	325	Free
AP5319	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -RO	Excellent surface flatness	Vitreous	90	-	810-10	55	580	720	Gray	Gray	-	>1500	-	1.5	325	Free

## Developing Products

5316A	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -RO	Excellent surface flatness	Vitreous	80	-	810-10	55	580	720	Gray	-	>2000	-	-	1.5	325	-	Free
-------	---	----------------------------	----------	----	---	--------	----	-----	-----	------	---	-------	---	---	-----	-----	---	------

Characteristics  
 ● Outstanding surface flatness, resistance to wear, and heat resistance make them ideal as over coats for various kinds of print heads, including heaters, image sensors and thermal heads.

● AP5347/AP5348 and AP5349 are for heaters. AP5352B is for image sensors, and AP5580 and AP5580 series are for thermal heads.

● AP5317 and AP5717 are for AIN coat. (AP5317: Top layer, AP5717: Bottom layer)

## AP Primary Coat Glass Paste for Chip Resistor

Code	Glass Type	Paste and Fired Glass Feature	Glass Characteristics	Paste Viscosity (Pa·s)	Paste Specific Gravity	Firing Condition (°C-min.)	Thermal Expansion Coeff. (X10 <sup>-7</sup> /°C)	Viscosity Property (DTA)		Color	Electrical Property			Particle Property			Lead Free or Contd.
								Transfer-Softening Point (°C)	Crystal-ization Temp.(°C)		Insulation Resistance (Ω)	Fired Glass	Breakdown Voltage (V)	tan δ (%)	Average Particle Size (μm)	Particle Size (Center Value) (μm)	
AP5231	SiO <sub>2</sub> -PbO	Excellent acid-proof characteristics and stability of resistance	Vitreous	160	2.5	600-10	73	480	600	Green	>10 <sup>10</sup>	>500	-	2.0	-	325	Contd.

## AP Second Coat Glass Paste for Chip Resistor

Code	Glass Type	Paste and Fired Glass Feature	Glass Characteristics	Paste Viscosity (Pa·s)	Paste Specific Gravity	Firing Condition (°C ~min.)	Thermal Expansion Coeff. (X10 <sup>-7</sup> /°C)	Viscosity Property (DTA)		Color	Electrical Property		Particle Property			
								Transfer Softening Point (°C)	Crystal-ization Temp.(°C)		Insulation Resistance (Ω)	Fired Glass	Paste	tan δ (%)	ε	Average Particle Size (μm)
P5215A	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -PbO	Excellent acid-proof characteristics	Vitreous	300	-	600-5~10	68	470	575	White	-	-	-	-	325	Contd.
P5215B	SiO <sub>2</sub> -B <sub>2</sub> O <sub>3</sub> -PbO	Excellent acid-proof characteristics	Vitreous	100	-	600-5~10	68	470	575	Black	>10 <sup>10</sup>	>500	-	-	325	Contd.
P5216B	SiO <sub>2</sub> -PbO-B <sub>2</sub> O <sub>3</sub>	Excellent acid-proof characteristics	Vitreous	210	-	590-5~10	64	475	575	Black	>10 <sup>10</sup>	>500	-	-	325	Contd.
P5236	SiO <sub>2</sub> -PbO	Excellent surface flatness	Vitreous	170	-	600-5~10	75	485	590	Green	>10 <sup>10</sup>	>500	-	-	325	Contd.

## AP Marking Glass Paste for Chip Resistor

Code	Glass Type	Paste and Fired Glass Feature	Glass Characteristics	Paste Viscosity (Pa·s)	Paste Specific Gravity	Firing Condition (°C-min.)	Thermal Expansion Coeff. (X10 <sup>-7</sup> /°C)	Viscosity Property (DTA)		Color	Electrical Property			Particle Property		Lead Free or Contd.	
								Softening Point (°C)	Crystallization Temp.(°C)		Insulation Resistance (Ω)	Breakdown Voltage (V)	tan δ (%)	Average Particle Size (μm)	Particle Size (Center Value) (μm)		Sieving Mesh Pass
AP5346WW	SiO <sub>2</sub> -PbO-B <sub>2</sub> O <sub>3</sub>	Excellent resolution	Vitreous	170	-	510-5	72	400	485	White	-	-	-	1.2	-	325	Contd.
AP5216W	SiO <sub>2</sub> -PbO	Excellent acid-proof characteristics	Vitreous	150	-	590-5-10	64	470	575	White	-	-	-	-	1.7	325	Contd.

# Glass Powder & Paste & Green-sheet for PDP

## Sealing Glass Powder for Glass Panel, PD200 or AS ( Soda Lime )

Code	ASF1304M	ASF1304Z	ASF1200M	ASF1200A	WVF2300M	DT430-150
Glass Characteristics	Crystalline		Vitreous		Vitreous	
Glass Type	BzO <sub>3</sub> ·PbO·ZnO		BzO <sub>3</sub> ·PbO		SiO <sub>2</sub> ·BzO <sub>3</sub> ·PbO	
Thermal Expansion Coeff. ( × 10 <sup>-7</sup> /°C ) <sup>*1</sup>	83	88	72	73	67	72
DTA Transformation Point (°C)	320	320	320	320	307	310
DTA Softening Point (°C)	400	400	390	380	353 <sup>*3</sup>	360 <sup>*3</sup>
DTA Crystallization Temp.(°C)	515	515	-	-	-	-
Flow Button Diameter (mm φ) <sup>*2</sup>	-	-	21	21	-	-
Color	Black	Black	Black	Black	Black	Black
Substrate Strain after Sealing (kg/cm2) <sup>*3</sup>	-50~+50	-50~+50	-50~+50	-50~+50	-	-
Specific Gravity	6.1	6.1	5.8	5.8	7.2	7.2
Average Particle Size (μm) <sup>*4</sup>	4.0	4.0	5.0	5.0	-	-
Sieving Size ( Mesh Pass )	150	150	150	150	-	-
Firing Condition (°C—min.)	450-30	450-30	450-10	450-10	430-10	430-10
Usage	PD200	AS	PD200	AS	PD200	AS

\*1: 50~300°C/crystalline types, 50~250°C/vitreous type

\*2: Fired at 450°C-10min. For vitreous, 450°C-30min. For crystalline, 12.8mm diam. Pre-pressed glass with the same specific gravity value

\*3: "+": Frit compression, "-": Frit extension

\*4: Air-permeability method

\*5: Third inflection point on DTA curve

2004.April version

## Dielectric Paste ( Clear ) for Front Panel, PD200

Code	YPT340	YPT065F
Glass Type	PbO·BzO <sub>3</sub> ·SiO <sub>2</sub>	PbO·BzO <sub>3</sub> ·SiO <sub>2</sub>
Color (After Firing)	Clear	Clear
Thermal Expansion Coeff. ( × 10 <sup>-7</sup> /°C ) <sup>*1</sup>	75	74
DTA Transformation Point (°C)	490	460
DTA Softening Point (°C)	585	560
Paste Viscosity(Pa·S) <sup>*2</sup>	100~180	100~180
Firing Condition (°C—min.)	580-30	580-30
Usage	Sintered	Sintered

\*1: Temperature range 50~350°C

\*2: Brookfield rotary viscometer, 10rpm, 25°C

## Rib Paste for PD200

Code	RPW401	RPW032
Glass Type	PbO·BzO <sub>3</sub> ·SiO <sub>2</sub>	PbO·BzO <sub>3</sub> ·SiO <sub>2</sub>
Color (After Firing)	White	White
Thermal Expansion Coeff. ( × 10 <sup>-7</sup> /°C ) <sup>*1</sup>	73	73
DTA Transformation Point (°C) <sup>*2</sup>	460	450
DTA Softening Point (°C) <sup>*3</sup>	560	550
Paste Viscosity(Pa·S) <sup>*3</sup>	40~100	40~100
Firing Condition (°C—min.)	550~570-10	530~550-10
Usage	High Dense	High Dense

\*1: Temperature range 50~350°C

\*2: Brookfield rotary viscometer, 10rpm, 25°C

\*3: Glass powder only

## Dielectric Paste for Rear Panel, PD200

Code	AP5670
Glass Type	PbO·BzO <sub>3</sub> ·SiO <sub>2</sub>
Color (After Firing)	White
Thermal Expansion Coeff. ( × 10 <sup>-7</sup> /°C ) <sup>*1</sup>	72
DTA Transformation Point (°C)	450
DTA Softening Point (°C)	560
Paste Viscosity(Pa·S) <sup>*2</sup>	100~180
Firing Condition (°C—min.)	560~570-10
Usage	For Under Rib

\*1: Temperature range 50~350°C

\*2: Brookfield rotary viscometer, 10rpm, 25°C

## Dielectric Green Sheets for Rear Panel, PD200

Code	AGS7001
Glass Type	PbO·BzO <sub>3</sub> ·SiO <sub>2</sub>
Color (After Firing)	White
Thermal Expansion Coeff. ( × 10 <sup>-7</sup> /°C ) <sup>*1</sup>	72
DTA Transformation Point (°C)	450
DTA Softening Point (°C)	560
Firing Condition (°C—min.)	560~580-30
Usage	For Under Rib

\*1: Temperature range 50~350°C

## Dielectric Paste for Black Stripe

Code	AP5695(BMP065)
Glass Type	PbO·BzO <sub>3</sub> ·SiO <sub>2</sub>
Color (After Firing)	Black
Thermal Expansion Coeff. ( × 10 <sup>-7</sup> /°C ) <sup>*1</sup>	90
DTA Transformation Point (°C)	455
Paste Viscosity(Pa·S) <sup>*2</sup>	70~130
Firing Condition (°C—min.)	580-30

\*1: Temperature range 50~350°C

\*2: Brookfield rotary viscometer, 10rpm, 25°C

## AS Tube for Exhaustion

Item	AS Tube
Thermal Expansion Coeff. ( × 10 <sup>-7</sup> /°C ) <sup>*1</sup>	87
Tube OD (mm φ)	5
ID (mm φ)	3

\*1: Temperature range 50~350°C